Claims 1-3 have been rejected under 35 USC 103 as being unpatentable over Koda et al or Okubo in view of Araki and Nishiura. This rejection is deemed moot due to the cancellation of claims 1-3. Further, it is inapplicable to new claims 6-20 for the following reasons.

In a preferred embodiment, the present invention is directed to a liquid crystal active-matrix display device. The device comprises a plurality of parallel sources lines disposed on a substrate in a first direction and a plurality of parallel gate lines disposed on a substrate in a second direction, perpendicular to the first direction. A plurality of thin film transistors, each including a gate, source and a drain electrode, are disposed at intersections of the parallel gate lines and the parallel source lines. Further, a plurality of picture element electrodes are disposed on the substrate in a matrix fashion so as to each correspond to one of the thin film transistors. Each of the thin film transistors are used for switching applied voltages to drive each of the corresponding picture element electrodes.

The gate electrodes of each of the transistors are formed of a non-transparent material, for example, tantalum. These gate electrodes are formed such that the gate electrodes and a non-corresponding adjacent picture element electrode overlap at edge portions thereof to thereby form an additional capacitor electrode at the overlapped edge portions. In other words, the additional capacitor electrodes are formed by gate

electrodes of one transistor and a picture element electrode which corresponds to a different adjacent transistor. The overlapped portions of the gate electrode and the picture element electrode thereby form an additional capacitor electrode. Further, there are first and second insulating layers which separate each of the overlapped edge portion of the picture element electrodes and gate electrodes.

The Examiner alleges that the basic structure of claims 1-3 is shown in Koda's figures 1-3 and Okubo's figures 1-6 and 17. Koda et al is directed to a liquid crystal display panel for line-at-a-time driving at a TV rate, an array of field effective transistors switches, to enable inputs to respective storage capacitors thereby providing storage of signals for a sufficient time for the liquid crystal material to respond. The drain pad of the transistors also serve as one plate of the associated storage capacitor and a portion of its gate electrode is effectively the second plate. This thereby minimizes the number of drive lines required and facilitates the fabrication of a practical device using state-of-the-art thin film transistor technology.

As claimed in claims 6 and 14 of the present invention, Koda clearly fails to teach that gate electrodes and a non-corresponding picture element overlap at edge portions thereof to form additional capacitors or additional capacitor electrodes. Koda et al clearly shows, with regard to Figure 4, that gate electrodes or gate lines 44 are clearly connected only with corresponding picture elements

in that gate line, for example, 52. However, with regard to the present invention, as claimed in claims 6 and 14, a plurality of thin film transistors, each including a gate, source and drain electrode, correspond to each of a plurality of picture element electrodes. These corresponding transistors drive the corresponding picture element electrodes. However, in contradistinction with Koda et al, gate electrodes form additional capacitor electrodes with non-corresponding adjacent picture element electrodes. This is due to the fact that, as the gate electrodes are formed, they are extended so as to overlap at edge portions with a non-corresponding picture element electrode.

Further, with regard to claim 14 of the present invention, these gate electrodes are formed of a non-transparent material. This is because the gate electrodes merely overlap with a portion of the picture element electrodes. With regard to Figure 4 of Koda et al, the gate electrodes 44 clearly cannot be formed of such a non-transparent material, in that the gate electrodes are underneath the entirety of the picture element electrode. Therefore, if these gate electrodes are built of a non-transparent material, sufficient light would not escape to the picture element electrode and an insufficient display would arise. However, in contradistinction with Koda et al, the present invention as claimed in claim 14, merely utilizes a portion of the gate electrodes to overlap with a portion of the picture element electrodes. Therefore, these

gate electrodes can be of a non-transparent material, in that, the majority of the picture element electrodes does not overlap with the gate electrode. Therefore, in contradistinction with that of Koda et al, the gate electrodes can be formed of a non-transparent material such as tantalum, and can therefore form stronger and better additional capacity electrodes in a smaller surface area than that utilized by Koda et al.

The gate electrode that overlaps a picture element electrode so as to function as an additional capacitor electrode is a gate electrode that is adjacent to the gate electrode of the thin film transistor for driving picture elements formed by the picture element electrode. The potential level of each additional capacitor electrode is preferably unchanged during the holding period, (i.e., from the time when a previous writing operation has been completed to the time when the next writing operation begins). However, because the gate electrodes also function as additional capacitor electrodes for the adjacent picture element electrodes, a gate driving pulse is applied to the gate electrodes during the holding period when the adjacent picture element potential should be maintained at a certain level, as determined by the writing operation. This pulse raises the picture element potential level through the additional capacitors, so that the operation point of the thin film transistors is shifted. The shift in operation in the operation point of the thin film transistors takes place in the

direction such that the OFF bias of the thin film transistors becomes more negative, and electric charge which is stored in the additional capacitors does not flow out of the additional capacitors. This aids in providing a liquid crystal active-matrix display device in which the additional capacitors improve the picture element-retaining characteristics and reduce the shift in picture element electrode potential level at the time of the fall of the gate driving pulse, resulting from the capacitance between the gate electrodes and the drain electrodes. Further, these additional capacitor electrodes are formed with a large capacitance at a high yield, with little effect on other processes, even though the surface areas of the electrodes that are providing the additional capacitance, are small. This is clearly superior to that of Koda et al.

Further, as claimed in claim 6 of the present invention and further, as claimed in claim 15, the first and second insulating layers-separate each of the overlap edge portions of the picture element electrodes and gate electrodes. Thus, with the gate electrodes being made of tantalum, the first insulating film may be made of tantalum pentoxide, through a simple oxidation process. The tantalum pentoxide has a high dielectric constant, and therefore, even the surface areas of the electrode for providing additional capacitance are small, the high dielectric constant allows for a more effective additional capacitance electrode.

With regard to Okubo, as shown in Figures 1-6 and 17, it appears as though the drain electrodes form the picture element electrodes. Further, the picture element electrodes are disposed over the gate electrodes such that the gate electrodes are underneath the entirety of the picture element electrodes, in contradistinction to that of the present invention as claimed in claims 6 and 14. Therefore, as previously described with regard to Koda et al, Okubo clearly cannot utilize a gate electrode formed of a non-transparent material in that this would provide for an ineffective display device. If the gate electrode was formed of a non-transparent material, sufficient light would not be able to escape through the picture element electrode, and an ineffective display device would be shown. Therefore, Okubo clearly utilizes a gate electrode formed of a transparent material. Further, as can clearly be seen with regard to Okubo, the additional capacitor electrodes are clearly not formed between the gate electrodes of each of the transistors and a non-corresponding adjacent picture element electrode overlapping at edge portions thereof. The gate electrodes clearly correspond to the picture element electrodes, and the additional capacitor electrodes are formed with regard to corresponding transistors and their picture element electrodes. <u>However, in contradistinction, with regard to claims 6 and 14 of the present invention, gate electrodes of each transistor and a non-corresponding adjacent picture element electrode, overlap at edge portions.</u> Therefore, for

reasons previously mentioned with regard to Koda et al, the present invention, as claimed in claims 6 and 14, is clearly not taught or suggested by Okubo.

Also, with regard to claim 17 of the present invention, each gate line is made in one piece connecting a plurality of corresponding gate electrodes. Further, with regard to claims 13 and 20, each gate line overlaps the peripherally of a plurality of adjacent picture element electrodes, to thereby minimize light from leaking from each of the picture element electrodes. The area where each of the picture element electrodes overlaps each of the gate electrodes, is preferably, as claimed in claims 13 and 20, located in a long, narrow strip fashion on the outskirts of the picture element electrodes. Thus, a decrease in the opening ratio of the picture element electrodes can be minimized. This construction is effective when the liquid crystal display device is driven under normally white mode (a mode in which the display device exhibits white when no electric field is supplied), and the transmittance of the liquid crystal decreases with an increase in the voltage to be applied, for example, a twisted pneumatic display device with polarizers arranged in a cross fashion. In a normally white mode, light leaks from the space between each picture element electrode and each gate line or its source line which causes difficulties in obtaining high contrast. This is clearly not taught or suggested with regard to Okubo, or Koda et al, which merely show gate electrodes formed under the

entirety of picture element electrodes. Thus, a further advantage of the present invention, as claimed in claims 13 and 20, is also realized.

The Examiner attempts to utilize Araki and Nishiura for teachings of an insulating layer made of tantalum pentoxide and silicon nitride. However, these references clearly fail to make up for the previously mentioned deficiencies with regard to Okubo and Koda et al. Thus, each of the references of record, Koda et al, Okubo, Nishiura, and Araki, either singly or in combination, fail to render the present invention, as claimed in independent claims 6-14, obvious. There is clearly no teaching in any of the references of gate electrodes of each of the transistors and a non-corresponding adjacent picture element electrode, overlapping at edge portions thereof to form an additional capacitor electrode. Further, as claimed in claim 14, there is clearly no showing of the gate electrode being formed of a non-transparent material. Thus, as previously mentioned, Araki and Nishiura clearly fail to make up for the previously mentioned deficiencies with regard to Koda et al and Okubo.

Accordingly, in view of the above amendments and remarks, reconsideration of the objections and rejections and allowance of claims 6-20 of the present invention are respectfully requested.

Pursuant to the provisions of 37 C.F.R. 1.17 and 1.136(a), the Applicants hereby petition for an extension of one month to February 11, 1990 for the period in which to file a response to the outstanding Office Action. The required fee of $62.00 is attached hereto.

Please charge any fees or credit any overpayment pursuant to 37 C.F.R. 1.16 or 1.17 to Deposit Account No. 02-2448.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH

By: Anthony J. Birch 2/6/90
for Michael K. Mutter
Registration No. 29,680

301 North Washington Street
P.O. Box 747
Falls Church, Virginia 22046-0747

MKM/DJD/jao
(703) 241-1300
717-159P